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RICHARDS IMPROVED  
PULSATOR JIG

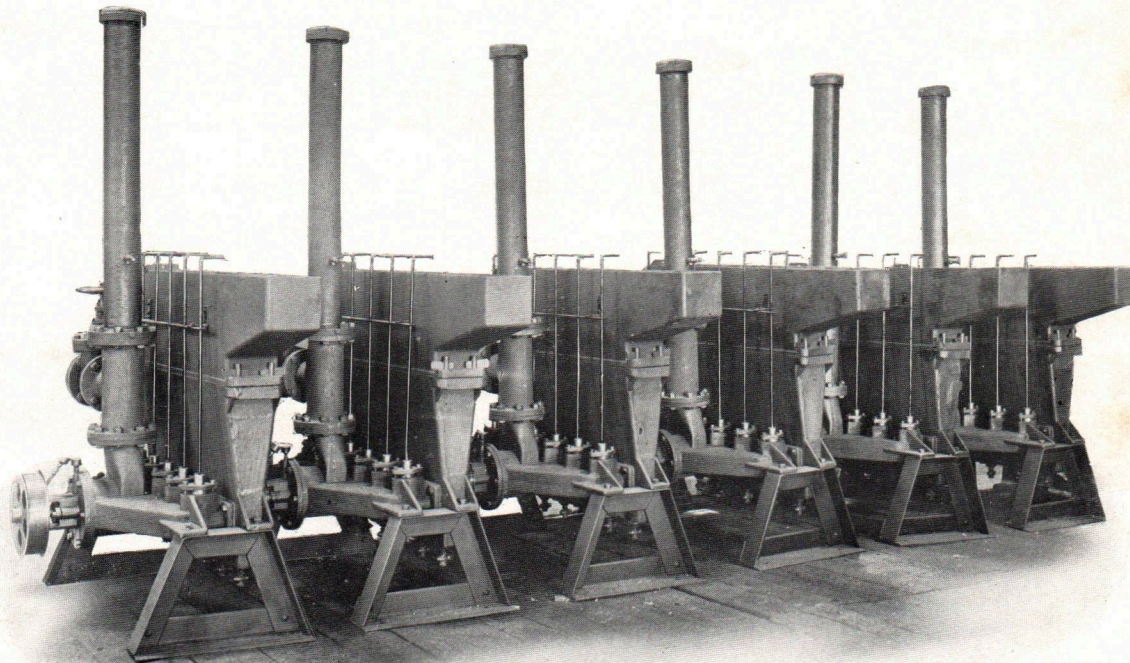


FIG. 896. 7 INCH, 6 COMPARTMENT RICHARDS PULSATOR JIGS. COMBINED CAPACITY APPROXIMATELY 1200 TONS. MADE ENTIRELY OF IRON AND BRASS—ONLY ONE MOVING PART TO EACH JIG

# RICHARDS PULSATOR JIG

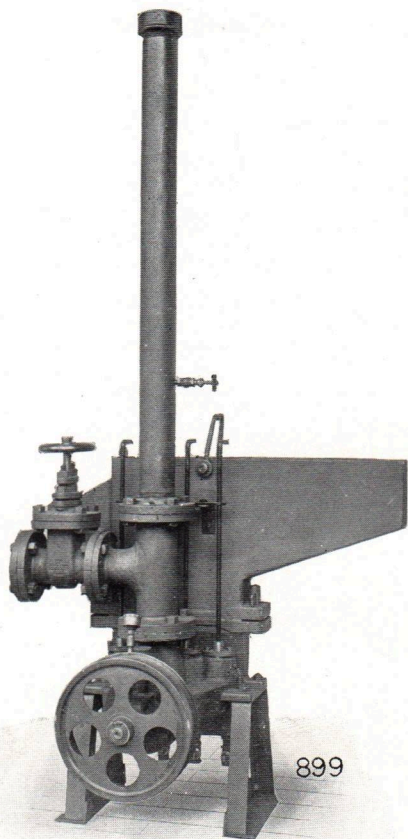


FIG. 899. REAR VIEW OF 4 INCH, 4 COMPARTMENT,  
80 TON CAPACITY, RICHARDS PULSATOR JIG.  
FLOOR SPACE 32 INCH X 41 INCH.

The Richards Pulsator Jig performs the same functions as any jig but does it in about 1.5% of the space, with 20% of the water, 5% of the power, 3% of the weight and about 1% of the screen surface of the plunger or Harz type of jig.

The function of the Richards Pulsator Jig is the same as other jigs, namely, to concentrate ore too coarse to be treated on a concentrating table.

Wonderful as this jig is, however, it will not separate mineral from gangue if the mineral has not previously been liberated by crushing. It will not jig non-jigging ore; it will not do good work on badly screened ore; it will not operate on hutch water that is 50% mud and 40% old leaves and chips; it will not get mineral from ore having no mineral; it will not operate for a jig man who condemns it on sight; and it cannot possibly succeed for a man who lets his men and machines run him.

So many impossible qualities have been attributed to the Richards Pulsator Jig that we are compelled to enumerate some of the things this jig will *not* do. It is nothing but a jig and as such will do only what other jigs have been known to do.

The Richards Pulsator Jig has been developed by us from data obtained by Dr. Robert H. Richards, the eminent author of "Ore Dressing," during his years of investigation of jigging, sizing and classification of ores. It is an invention that naturally followed that of the well-known Richards Pulsator Classifier.

The Richards Pulsator Jig is similar in many respects to the ordinary plunger type of jig except no plunger is used and by the use of a peculiar form of pulsating water current one square inch of screen surface is made to do the work of 190 square inches of screen surface of the ordinary jig.

This pulsating current is forced upward through the jig screen—always upward—there is no suction stroke, also no clogging of the screen as in the plunger type jig. This is also one reason for the enormous capacity of the Richards Jig.

Under the action of this upward pulsating current the entire mass of the jig bed is always properly loose and open, allowing the mineral particles to fall quickly to their proper level while the gangue particles are rapidly forced to the upper layers to be discharged with the tailings. This is still another reason for the great capacity of the Richards Jig.

### COMPARATIVE SIZE

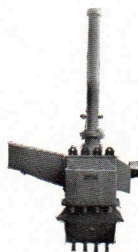


FIG. 747

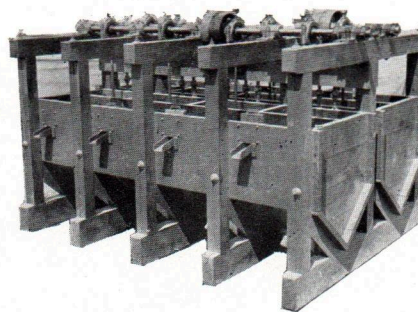


FIG. 668

COMPARATIVE SIZE OF RICHARDS AND PLUNGER TYPE JIGS AS SHOWN BY PHOTOGRAPHS MADE TO THE SAME SCALE. THREE PLUNGER JIGS FIG. 668 ARE REQUIRED TO EQUAL IN CAPACITY THE ONE RICHARDS JIG, FIG. 747

### SCREEN AREA

One Richards Pulsator Jig having four compartments, each 4 in. x 4 in., equal to a total screen area of 64 square inches, has developed as great a capacity as three double, four compartment, plunger type jigs, each screen being 17 in. x 30 in., or a total screen area of 12,240 square inches; hence one square inch of screen surface in the Richards jig is equivalent, in capacity, to approximately 200 square inches of screen surface in the plunger type jig.

### SPACE OCCUPIED

Three double, four compartment, plunger type jigs occupy a floor space of 530 square feet. A Richards Jig of the same capacity occupies less than 8 square feet. One reciprocating screen type jig with a capacity of 400 tons in 24 hours occupies a space 6 feet wide, 25 feet long and 10 feet high. A Richards jig of the same capacity would require only 4 ft. x 5 ft. x 6 ft.

### WEIGHT

The weight of plunger type jigs, 90 tons capacity, is about 15 tons. The same capacity Richards jig, 1,200 pounds. A mill floor to sustain 15 tons would have to be a pretty substantial structure. In almost any existing mill, space could readily be found for a Richards jig of 90 tons capacity.

### PARTS TO LUBRICATE

Three plunger type, double, four compartment jigs have 60 places to lubricate and 66 moving parts as compared with 1 place to lubricate and 1 moving part in the Richards jig.

### WATER CONSUMPTION

Table 294, in Richards "Ore Dressing" gives the hydraulic water required for jigs in American mills. This amount varies from 2,100 gallons to 13,200 gallons and the average is about 4,700 gallons of water per ton of ore treated. In European practice the average requirement of hydraulic water is about 3,400 gallons per ton of ore treated.

The Richards jig, treating copper ore of 2% to 3% copper, screen sized between 8 mm. and  $2\frac{1}{2}$  mm. required only 1,000 gallons of water per ton of ore treated. The improved form of concentrates discharge gate now used reduces the amount of water required to a still lower figure. Of the entire amount of water used in the Richards jig, that portion issuing with the concentrates is perfectly clear and may be returned to the mill system. No other jig gives clear water.

### RANGE OF JIG FEED SIZES

The standard sizes of Richards Pulsator Jigs are designed for feed sizes from  $\frac{5}{8}$  inch diameter to 1 mm. diameter.

Special conditions may demand jigging ores as coarse as  $2\frac{1}{2}$  inches in diameter. Special sizes of Richards jigs can be furnished for feed sizes larger than  $\frac{5}{8}$  inch.

Modern mill practice dictates that jig feed may be carried down as small as 1 mm.; below that concentrating tables are necessary. On the other hand, with proper hydraulic classification, such as obtained with the Richards Pulsator Classifier, table feeds may be as coarse as 2 mm.

[illegible]

The illustration gives a very good idea of the extremely small space occupied by the Richards apparatus. The jig and classifier are on the second floor, utilizing the waste spaces of former mill systems.

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## RICHARDS PULSATOR JIG

### TABLE OF SIZES, CAPACITIES AND DIMENSIONS

SIZE		Approximate Capacity, Tons in 24 Hours	SPACE OCCUPIED			Approximate Gallons of Hydraulic Water Per Minute	Size of Hydraulic Water Pipe, Inches	Size of Pulley Inches		H. P. to Drive
Size of Comp. Inches	No. of Comp.		Width, Inches	Length, Inches	Height, Inches			Dia.	Face	
3x3	4	20 to 30	28	36	40	15 to 25	2½	12	2¾	1-10
4x4	4	60 to 90	32	41	48	45 to 65	3	12	2¾	⅛
7x7	4	100 to 150	39	55	52	75 to 115	4	12	2¾	¼
6x6	2	70 to 100	31	36	45	55 to 75	2½	12	2¾	⅛
8x8	2	100 to 150	35	41	50	75 to 115	3	12	2¾	¼
12x12	2	200 to 300	42	50	56	150 to 225	4	12	2¾	⅓

CAPACITY IS BASED ON AVERAGE CONDITIONS AND REASONABLE AMOUNT OF MINERALS IN THE ORE, BUT IS SO MUCH AFFECTED BY THE SCREEN RATIO USED, EFFICIENCY OF SCREENING, KIND OF ORE AND SPECIFIC GRAVITY OF ORE THAT FIGURES GIVEN IN THE TABLE ARE NOT GUARANTEED.  
 HEIGHT IS TO TOP OF FEED SPOUT--DOES NOT INCLUDE AIR COLUMN.

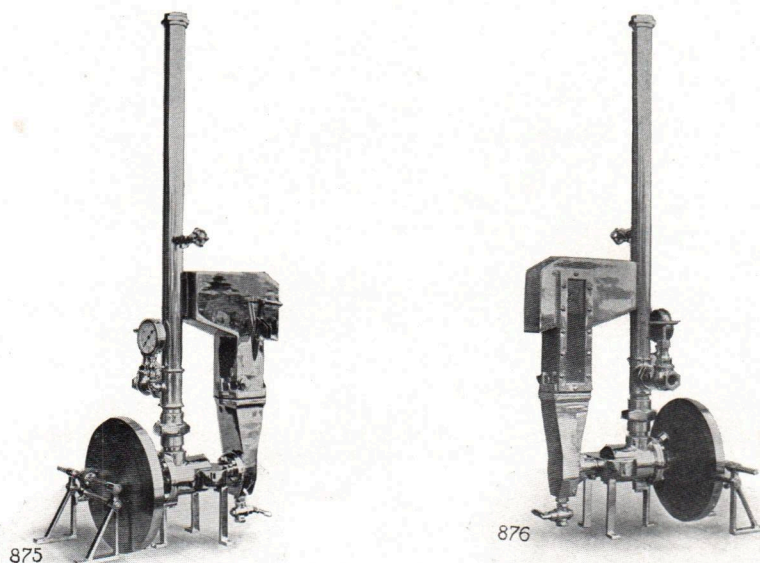


FIG. 875-876. 3 INCH SINGLE COMPARTMENT RICHARDS PULSATOR JIG FOR LABORATORY WORK, EQUIPPED WITH TUBE DISCHARGE, GLASS SIDE FOR VIEWING JIGGING ACTION AND FRICTION DRIVE FOR CHANGING SPEED OF PULSATOR VALVE,

THE RICHARDS PULSATOR JIG IS PATENTED IN THE UNITED STATES AND IN ALL THE PRINCIPAL FOREIGN COUNTRIES.

## DESCRIPTION OF CONSTRUCTION AND OPERATION

The part above the screen of the Richards jig (see Fig. 0244) is practically the same as any plunger type jig except that it is much smaller in screen surface area. The concentrates discharge gates and seals may be the familiar Harz type or the new inclined tube discharge used exclusively on the Richards jig, or it may be an ordinary plug discharge. The tailings gate is practically the same as the Harz. The method of feeding is the same.

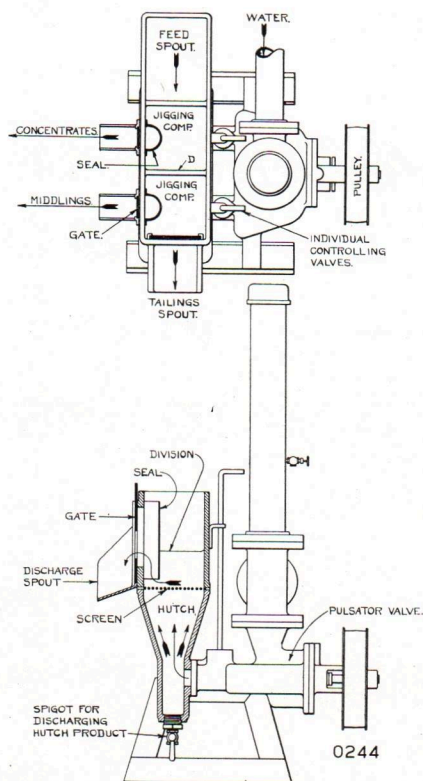


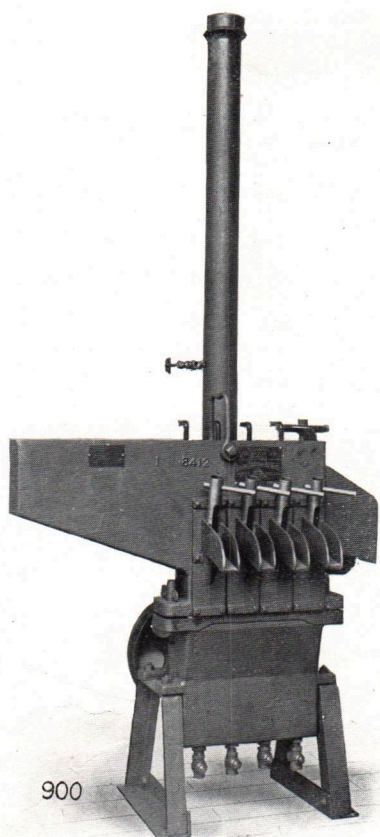
FIG. 0244. DRAWING SHOWING PRINCIPAL PARTS OF RICHARDS PULSATOR JIG

the upward pulsating current, the heavier particles of mineral settling to the screens and accumulating there pass under the seal and out the concentrates discharge gate. The seal allows only the heavy mineral down on the screen to pass to the discharge gate because the lighter material which must necessarily ride on top of the heavy mineral, cannot get down to the bottom of the seal to pass under it.

Mineral or middlings that may not settle in the first compartment are settled in the second and discharged as before. The lightest particles or tailings are held up by the jigging action of the pulsating current and are carried out the tailings spout.

That part under the screen, namely, the hutch, is quite different. There is no plunger compartment and no plunger. The hutch of the Richards jig is of a long V shape with the water entering at the lowest point on the side. Before entering the hutch the water (called hydraulic water because it is under pressure) passes through the pulsator valve, the rotary motion of which gives the peculiar pulsating effect to which the jig owes its wonderful capacity. The hydraulic water entering the hutch of each jigging compartment is controlled in amount by individual hand operated valves located between the pulsator valve and the hutch. An air chamber located over the pulsator valve intensifies the pulsation as well as prevents water hammer in the supply pipe.

The material fed to the jig is delivered first to the feed hopper; from there it runs into the first compartment, then to the next, and so on, towards the tailings discharge spout. In each compartment the ore is subjected to the jigging action of



FRONT VIEW OR CONCENTRATES DISCHARGE SIDE OF 4 INCH, 4 COMPARTMENT RICHARDS PULSATOR JIG. 80 TON CAPACITY, WITH TUBE DISCHARGES. FLOOR SPACE 33 INCH X 41 INCH.

The bed of mineral in the jigging compartments may be as shallow as in a Harz jig, i. e., 4 inches, or as deep as 10 inches, which latter condition can exist only in the Richards jig. Because of the unusual mobility of the bed in a Richards jig, the particles of ore obey the law of liquids and flow almost as readily. Hence the seal acts as the short leg of a U tube and as fast as the height of mineral outside of the seal increases it presses the mineral up into the seal just as it would in a U tube.

Eventually the height of mineral in the seal would become as great as that outside it but for the discharge gate, which allows the mineral to escape. By adjusting the height of the discharge gates the mineral concentrates are discharged as fast as they accumulate.

The column of mineral in the seal will cease discharging as soon as the level of mineral outside the seal drops to the level of the discharge gate. If the gangue only is fed to the jig then it passes over the bed and out the tailings gate. If mineral and gangue are fed to the jig the mineral accumulates in the jigging compartment, disturbs the balance between it and the seal, until a sufficient amount of mineral

is discharged from the gate to compensate for that which came into the jigging compartment. The gangue that came in with the mineral is carried over and out the tailings gate.

## SPECIFIC GRAVITIES

### LEAD ORES.

Galenite, lead sulphide .....	7.4 to 7.6
Cerussite, lead carbonate .....	6.4 to 6.6
Anglesite, lead sulphate .....	6.3 to 6.4

### COPPER ORES.

Melaconite, black copper .....	6.1 to 6.3
Cuprite, copper oxide .....	5.8 to 6.1
Chalcocite, copper glance .....	5.5 to 5.8
Bornite, copper sulphide .....	4.9 to 5.4
Chalcopyrite, iron and copper sulphide..	4.1 to 4.3
Malachite, copper carbonate .....	3.9 to 4.1
Chrysocolla, silicate of copper .....	2.0 to 2.2

### IRON ORES.

Mispickel, iron arsenic .....	5.9 to 6.2
Magnetite, iron oxide .....	5.1 to 5.2
Pyrite, iron bisulphide .....	4.9 to 5.1
Marcasite, iron sulphide .....	4.8 to 4.9

### ZINC ORES.

Smithsonite, zinc carbonate .....	4.3 to 4.5
Sphalerite, zinc blende .....	3.9 to 4.1
Willomite, zinc silicate .....	3.9 to 4.2

### GANGUE MATERIAL.

Barite, heavy spar .....	4.3 to 4.6
Manganese garnet .....	4.0 to 4.3
Iron garnet .....	3.8 to 3.9
Lime garnet .....	3.4 to 3.5
Fluorite, fluorspar .....	3.0 to 3.3
Anhydrite, gypsum .....	2.9 to 3.0
Dolomite, magnesian limestone .....	2.8 to 2.9
Quartz .....	2.6 to 2.7
Calcite, lime carbonate .....	2.5 to 2.7
Kaolinite, kaolin .....	2.6 to 2.7

## 0236



## DETERMINATION OF PROPER SCREEN OPENINGS FOR SIZING JIG FEEDS

The practical mill operator desires to know how great a range of size of particles may be fed to a jig without interfering with perfect jigging—which means what mesh screens to use to prepare the ore for feeding to the jigs. We have devised a diagram, 0237, from which may be obtained the exact information required for any ore.

This diagram is based on the laws of "Hindered Settling" (jigging) and on "Hindered Settling Ratios" determined by Dr. Richards, all of which will be found in Chapters 14 and 15, Vol. I, and Chapters 25 and 36, Vol. III, Richards Ore Dressing.

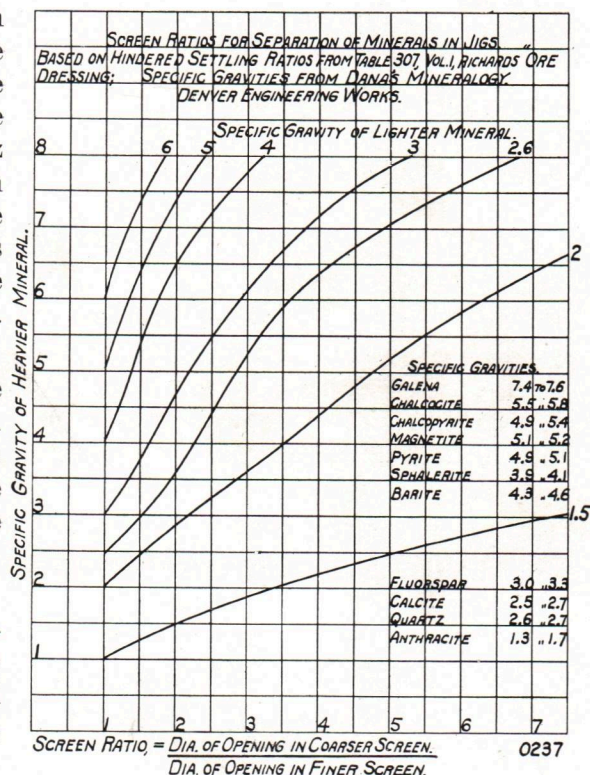
To use this Screen Ratio diagram it is necessary first to know the physical composition of your ore, that is, what minerals and gangues will be separated or liberated by crushing. Then must be found the specific gravity of each component by referring to the specific gravity table, page 8.

Suppose, for example, your ore when crushed separates into particles of pyrite and particles of quartz gangue. From the table, page 8, the specific gravity of pyrite is 5.0 and the specific gravity of quartz is 2.6. Now, referring to the diagram 0237, find 5.0 on the left and follow the horizontal line to the point where it meets the curve 2.6, then down vertically to the bottom of the diagram, which would be 2.8.

2.8 is the greatest screen ratio allowable in this case, but for safety we will use 2. This means that the largest particle in the jig feed must not be more than twice the diameter of the smallest particle in the same feed.

If it has been decided that profitable jigging may commence with ore crushed to  $\frac{1}{2}$  inch, then the first screening of jig feed would be through  $\frac{1}{2}$  inch on one-half of  $\frac{1}{2}$  or  $\frac{1}{4}$  inch opening.

The next screening would be through  $\frac{1}{4}$  on one-half of  $\frac{1}{4}$  or  $\frac{1}{8}$  inch. For an ore composed of galena and quartz the greatest ratio will be found to be 5.75 but for safety use 4.



Always in jigging, it is better to adopt as small a ratio as possible to insure a prompt separation. The nearer the particles of the jig feed approach a uniform diameter the better and quicker the separation between the mineral and gangue particles.

### NUMBER OF COMPARTMENTS REQUIRED

When only one mineral is to be separated from its gangue one compartment is generally sufficient and two ample, always provided, however, that the ore has been crushed sufficiently to produce free pieces of mineral and free pieces of gangue; that the feed to the jig has been properly and sufficiently screened between limiting sizes and that there is sufficient difference in the specific gravities of mineral and gangue to make separation by jigging possible.

If the crushing is such that particles of gangue still carry particles of mineral with them, forming compound particles of intermediate specific gravity, known as middlings, then two or three compartments are necessary. Such a separation requires considerable care in the preparation of the feed and no little skill in jigging.

To separate one mineral from another as well as both minerals from the gangue four compartments are necessary. Two mineral and gangue separation requires sizing within very narrow limits, maximum efficiency of sizing screens and the highest grade of skill.

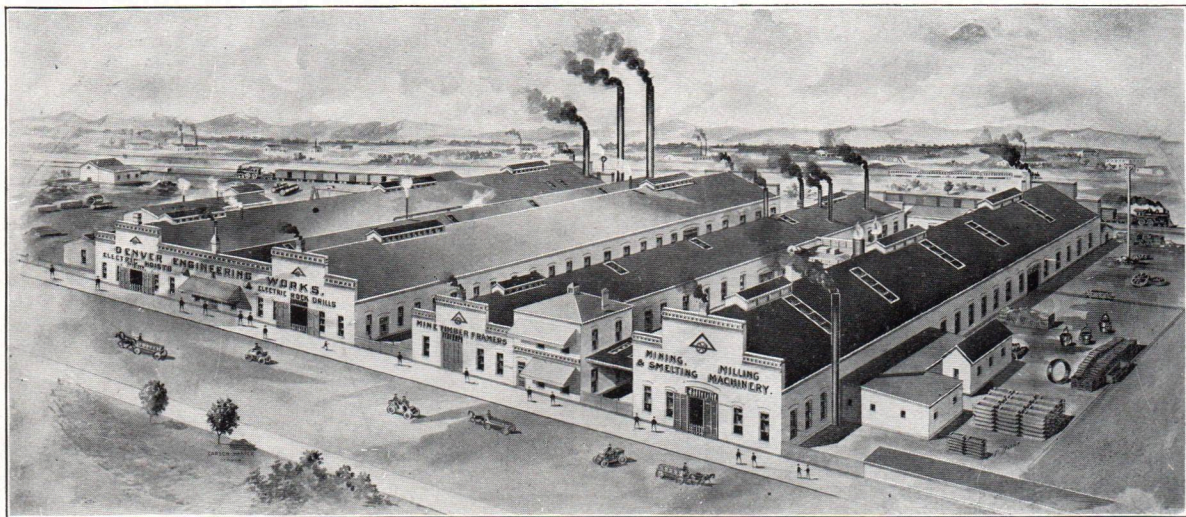
### ADVANTAGE OF SCREEN SIZING FEED TO JIGS

The proper size of the particles fed to any jig depends on the degree of crushing necessary to free entirely the mineral from its associated gangue. If in an elementary ore composed of pyrite and quartz the greater proportion of pyrite particles are say  $\frac{1}{8}$ -inch cubes, then the entire lot of ore must be crushed to  $\frac{1}{8}$ -inch cubes. The ideal condition would be that all pyrite particles and all quartz particles were  $\frac{1}{8}$ -inch cubes. If the greater proportion of pyrite particles were 1-16-inch cubes, then crushing must be finer and the whole lot of ore reduced to particles 1-16-inch cube.

The specific gravity of pyrite is about 5 and of quartz 2.6. Therefore the pyrite particle will be nearly twice as heavy as the quartz particle and in a jigging bed will promptly and readily be separated.

If the jig feed be composed of particles of widely varying sizes, the adjustments and pulsations that are correct for the large particles are not correct for the smaller particles.

We cannot expect ideal screen sizing in practice nor should we tolerate the miserable screening found in most mills, so we must establish limits that will meet reasonable conditions and at the same time give the jig something it can be expected to do.



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